

REMARKS

Claims 1, 3-9 and 15-17 are pending in the subject application. Claims 1, 7 and 15 have been amended. Claim 2 has been cancelled without prejudice. Support for the amendments is found throughout the specification as filed and no new matter is added by these amendments.

Favorable reconsideration in light of the remarks, which follow, is respectfully requested.

1. Claim Objections

Claim 15 has been objected to because the term "files" in line 2 appears to be a typographical error. Applicants have amended the term "files" to "films" to correct this typographical error. Reconsideration and withdrawal of the objection is respectfully requested.

2. 35 U.S.C. §102 Rejections

Claims 1, 3-9, 15 and 16

Claims 1 and 3-9 have been rejected under 35 U.S.C. §102(b) as being anticipated by Matsunaga et al (US 5,830,807). This rejection is moot. Claim 1, and thus the claims dependent thereon, has been amended (a) to incorporate the recitations of former claim 2, and (b) to recite that the change in gas in the chamber is made without extinction/regeneration of the plasma. As further discussed below, Neither Matsunaga, nor any combination of the references of record disclose or suggest such a process. The Office has already acknowledged that former claim 2 was not anticipated by Matsunaga.

Claims 7-9 have been rejected under 35 U.S.C. §102(b) as being anticipated by Watanabe et al (US 6,156,663). Claim 7, and thus the claims dependent thereon, has been amended (a) to incorporate the recitations of former claim 2, and (b) to recite that the change in gas in the chamber is made without extinction/regeneration of the plasma. As further discussed below, neither Watanabe, nor any combination of the references of record disclose or suggest such a process. The Office has already acknowledged that former claim 2 was not anticipated by Watanabe.

Claims 15-16 have been rejected under 35 U.S.C. §102(b) as being anticipated by Watanabe et al (US 6,156,663). The Office asserts, in part, that:

* * * Watanabe is also silent about stopping the generation of plasma after the etching using the first gas composition/first etching (col. 7, lines 5-7), which reads on completing the first etching without extinguishing the plasma, etching the stacked films by supplying a second gas composition into the process chamber, the second gas composition is different from the first gas composition (col. 7, lines 12-15). Watanabe is silent about stopping the generation of plasma between the two etching steps, which reads on the plasma is maintained without being extinguished until the second etching is started.

Applicants respectfully disagree.

Watanabe describes a method and apparatus for plasma processing. According to Watanabe, the sample is etched by using a mixed gas of BCl₃, Cl₂, CH₄ and Ar. (See e.g. col. 3, lines 36-40). Applicants respectfully disagree with the Office's assertion that Watanabe teaches:

changing the gas composition, pressure and power resulting in the etching of the layers 102 and 104 (Col. 7, lines 9-16; fig. 5(b) and fig. 5(c)), which reads on a change is made in the process gas in a plasma generation period according to any of the films that to be etched.

Watanabe does not disclose or suggest a continuous process where one set of etching conditions is utilized and then changed on the fly to produce a different set of etching conditions. Rather, according to col. 7, lines 9-16, when the etching conditions are gas flow rates of BCl₃:20 sccm, Cl₂:80 sccm, CH₄:4 sccm and a total gas pressure of 2 PA, a microwave output of 800 W, RF power of 60W and a substrate temperature of 40°C, the result is shown in Fig. 5(b) is obtained. On the other hand, when the gas flow rates are BCl₃:20 sccm, Cl₂:80 sccm, CH₄:4 sccm and Ar:96 sccm, and a total gas pressure of 3 PA, the result shown in Fig. 5(c) can be obtained. Thus, this portion of Watanabe merely appears to describe that different gas mixtures and pressures can be used to obtain different results. It does not describe a process wherein, during a plasma etching process on a single substrate (not a process on one substrate to determine the result and then another process on another substrate to determine the result), a change is made in the process gas.

Further, even if this portion of Watanabe could be interpreted to describe a process wherein during a process on a single substrate a change is made in the process gas, Watanabe does not describe explicitly or inherently a process wherein when a change is made in the process gas in a plasma generation period with the plasma being maintained throughout the etching with a first gas mixture, the change of the gas mixture to a second gas mixture and the etching with the second gas mixture, as recited in claim 15. Watanabe is devoid of any disclosure or suggestion of such an approach.

The Office Action looks upon Watanabe as if it were a patent claim, rather than a disclosure, and finds Watanabe sufficient to anticipate merely because, by not mentioning the concept of maintaining the plasma throughout a multiple etching process, Watanabe “reads on the plasma is maintained without being extinguished until the second etching is started.” That is not the correct legal test. These references generally teach plasma etching; thus they could be construed as “reading on” any plasma etching process whatever. But that is not the proper test for anticipation. To anticipate a claim, each and every element as set forth in the claim must be found, either expressly or inherently described, in a single prior art reference. *Verdegel Bros. v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

Applicants clearly claim a process wherein a change is made in the process gas in a plasma generation period without extinction/regeneration of the plasma. As acknowledged, Watanabe does not expressly describe maintaining the plasma during a change in process gas. Further, Applicants submit that this element would not have been inherent in the Watanabe process. As set forth in detail above Watanabe did not even clearly disclose a continuous process in which etching conditions are changed, as opposed to simply reporting different etching results under different etching conditions. In particular, inherency can only be established if the extrinsic evidence makes clear that the missing descriptive matter is necessarily present, and that it would be so recognized by persons of ordinary skill. *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999); MPEP §2112. In particular, “To serve as an anticipation when the reference is silent about the asserted inherent characteristic, such gap in the reference may be filled with recourse to extrinsic

evidence. Such evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." *Continental Can Co. USA v. Monsanto Co.*, 948 F.2d 1264, 1268, 20 USPQ2d 1746, 1749 (Fed. Cir. 1991); MPEP §2131.01.

As set forth above, extrinsic evidence (the conventional methods used by those of skill in the art) would teach the opposite. Thus, rather than make clear that the missing descriptive matter is necessarily present, the extrinsic evidence makes it probable that the missing descriptive matter is not present.

Accordingly, each and every element of claim 15 was not described, either explicitly or inherently, by Watanabe. Thus, claim 15 was not anticipated by Watanabe. Claim 16 depends from claim 15 and, likewise, was not anticipated by Watanabe. Reconsideration and withdrawal of the rejection is respectfully requested.

3. 35 U.S.C. §103 Rejections

Claims 1 and 3-9

Claim 2 had been rejected under 35 U.S.C. §103(a) as being unpatentable over Matsunaga et al (US 5,830,807) in view of Chung (US 5,658,820). Since the recitation of claim 2 has now been incorporated into claims 1 and 7, we will discuss the rejection in connection with those claims and the claims which depend therefrom.

The Office acknowledges that Matsunaga did not disclose changing bias voltage applied to the substrate together with the change made in the process gas/changing the gas mixture ratio in the plasma generation period/etching period, but asserts that Chung taught this and, thus, it would have been obvious to modify Matsunaga in view of Chung.

Applicants respectfully disagree. Matsunaga discloses and claims a process in which there are two alternate and selective etching steps which employ a common gas. See, e.g., Col. 3, ll. 11-19, Col. 5, ll. 53-56.

Chung does not describe a process wherein a change is made in the process gas or bias voltage. Rather, Chung describes a process for the manufacture of a ferroelectric thin-film wherein the film is etched by using Ar, chloric and fluoric gases of a predetermined composition ratio and an RF power of a predetermined frequency and power (see Abstract; col. 1, line 61 – col. 2, line 2). The Figures cited by the Office (Figs. 8-10) merely show graphs of etch rate vs. gas ratio (Fig. 8), etch rate vs. power applied to RF coil (Fig. 9) and etch rate vs. bias voltage (Fig. 10). The related text merely describes an experimental process wherein optimal gas ratios, power applied to RF coil and bias voltage can be determined by testing varying gas ratios, power applied to RF coil and bias voltage and plotting the results in graphical form (see col. 4, lines 11-64). Given the results shown in the graphs, one then uses the optimal results as the "predetermined" values to carry out the etching step.

The proposed combination of Matsunaga and Chung would not have taught or suggested a method wherein a change is made in the process gas in a plasma generation period and a simultaneous change is made in the bias voltage applied to the substrate. That approach provides a number of distinct advantages and improvements. For example, the ability to change the process gas according to the material of a film to be processed allows the cycle time to be shortened, and the ability to change the bias voltage permits the taper shape formed in the etching process by the sidewalls of the stacked films to be controlled. In conventional processes, each time the type of a film to be processed changes, the corona discharge is stopped and conditions are changed. That approach results in a discontinuous change in the taper shape.

When the taper shape changes discontinuously, and a film is formed in a subsequent stage on the stacked films, the resultant structure is locally thin at the discontinuity, leading to a problem that current leakage is likely to occur at the thinner portion of the stacked films.

By simultaneously changing the process gas and the bias voltage in the plasma generation process, the advantages of shortened cycle time and control of the taper

shape are achieved. Because the taper shape can be continuously changed, the above mentioned problems of discontinuity are avoided.

Accordingly, claims 1 and 7, and the claims dependent thereon, are patentable over Matsunaga in view of Chung. Reconsideration and withdrawal of the rejection is respectfully requested.

Claim 17

Claim 17 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Watanabe et al (US 6,156,663) in view of Whetten (US 1,153,754).

As set forth above, Watanabe does not teach or suggest a method wherein, a first etching with plasma is performed using a first process gas, completing the first etching without extinguishing said plasma, a second etching is performed by supplying a second process gas different from the first process gas where the plasma is maintained without being extinguished until the second etching is started.

Further, Whetten is merely cited as describing a method for forming an LCD by processing/plasma etching the stacked layers on the substrate to form a LCD. Whetten does not teach or suggest a method wherein, a first etching with plasma is performed using a first process gas, completing the first etching without extinguishing said plasma, a second etching is performed by supplying a second process gas different from the first process gas where the plasma is maintained without being extinguished until the second etching is started.

Accordingly, claim 17 is patentable over Watanabe in view of Whetten. Reconsideration and withdrawal of the rejection is respectfully requested.

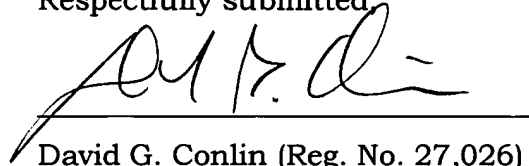
CONCLUSION

Reconsideration and allowance of claims 1-17 is respectfully requested in view of the foregoing discussion. This case is believed to be in condition for immediate allowance. Applicant respectfully requests early consideration and allowance of the subject application.

Applicants, conditionally petition for an extension of time to provide for the possibility that such a petition has been inadvertently overlooked and is required. As provided below charge Deposit Account No. **04-1105** for any required fee.

Should the Examiner wish to discuss any of the amendments and/or remarks made herein, the undersigned attorney would appreciate the opportunity to do so.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "D. G. Conlin", is written over a horizontal line.

David G. Conlin (Reg. No. 27,026)
EDWARDS & ANGELL, LLP
P.O. Box 55874
Boston, Massachusetts 02205
Tel. No. (617) 517-5512